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Education:

Ph.D., 1991, Cornell University, Physical Chemistry (Theoretical Chemistry minor)
Thesis topics: Photosynthetic energy transfer; Multiphoton spectroscopy.
Thesis title: "Multiphoton Absorption Studies in the Condensed Phase and an Examination of Femtosecond Energy Transfer in Photosynthetic Systems"
Thesis Advisor: Professor A.C. Albrecht.

M.S., 1986, Cornell University
Physical Chemistry, Theoretical Chemistry minor.

B.S., 1983, West Virginia Wesleyan College
Chemistry major, Mathematics minor.

Professional Experience:

1997 to present:
Technical Staff Member, Los Alamos National Laboratory. Interim Chief Scientist (2002-2003) for Center for Integrated Nanotechnologies (CINT) at Los Alamos and Sandia National Laboratories. Co-leader of Soft and Biological Nanomaterials Scientific Thrust area within CINT (2001-present), and leader of Biomolecular Materials, Spectroscopy and Imaging Team at LANL (2005-present).

1994 to 1997:
J. Robert Oppenheimer Fellow, Los Alamos National Laboratory, Chemical Science and Technology Division.

1991 to 1994:
National Institutes of Health Postdoctoral Fellow, Professor Richard A. Mathies, Department of Chemistry, University of California, Berkeley.

Research Interests:

Applications of spectroscopic techniques to the study of electron and energy transfer processes in biology, chemistry and nanoscale materials science; Theory of electron and energy transfer; Experimental and theoretical development of time-resolved and nonlinear spectroscopies, optical imaging methods, surface-specific spectroscopies, and Raman spectroscopies; Development and applications of thin-film nanostructured self-assembled materials and biomimetic membrane architectures; Biosensor technology; Spectroscopic studies of protein structure and dynamics.

Honors, Awards and Recognitions:

Symposium Organizer ("Developing Nano-bio Interfaces"), Materials Research Society Spring Meeting (2005)

Symposium Organizer ("Spatially Resolved Characterization of Local Phenomena in Materials and Nanostructures"), Materials Research Society Fall Meeting (2002).

National Institutes of Health Study Section member (*ad hoc* basis on BBCA study section (2001), and special study sections on Nanotechnology (2003, 2004, 2007)).

J. Robert Oppenheimer Fellowship (Los Alamos National Laboratory, 1994-1997).

Co-organizer of 7th International Conference on Time-Resolved Vibrational Spectroscopy (1995).

National Institutes of Health Postdoctoral Fellowship (UC Berkeley, 1991-1994).

Procter and Gamble Graduate Fellowship (Cornell University, 1990).

National Science Foundation Graduate Fellowship (Cornell University, 1984-1987).

Dow Graduate Fellowship (Cornell University, 1983).

Areas of Expertise:

Optical Spectroscopy and Imaging:

UV-VIS; FTIR; CD; Fluorescence (steady-state and time-resolved, including time-correlated single photon counting); Raman and resonance Raman (steady-state, time-resolved, surface enhanced, theory and analysis); Time-resolved spectroscopies (femtosecond to second, electronic and vibrational); Surface plasmon resonance; Optical and vibrational imaging; Design and construction of femtosecond, picosecond, nanosecond and continuous-wave laser systems; Integrated optical and evanescent wave instruments; Nonlinear optical methods.

Biophysics:

Protein separation, purification and handling; Applications of UV-VIS, FTIR, CD, fluorescence and Raman to address biological questions; Use of optical, fluorescence, vibrational and scanning probe imaging methods in biology; Characterization of biomimetic membranes and surfaces; Development and applications of biosensor technology.

Materials Science:

Development and applications of biomimetic materials; Langmuir trough methods; Thin-film self-assembled materials; Nanoporous and nanocomposite silica materials; Charge-transfer materials; Nonlinear energy localization in materials; Spectroscopy of materials and model compounds.

Theoretical:

Molecular dynamics, normal mode and quantum chemical calculations; Theory of linear, nonlinear and time-resolved spectroscopies; Theory of electron and energy transfer.

Program and Personnel Management:

Oversee multi-investigator and multi-disciplinary research projects; Team leader for team of 7 Ph.D. scientists and associated postdoctoral fellows, students and technicians; Experience leading successful large-team proposal development; Mentor undergraduate and graduate students, postdoctoral fellows and technical staff members in scientific work and career development.

Professional Affiliations:

Biophysical Society
American Chemical Society
American Physical Society
Materials Research Society
American Association for the Advancement of Science
Society for Applied Spectroscopy

Selected and Recent Professional Activities:

Scientific thrust leader (2001-present) and interim Chief Scientist (2002-2003) for the Center for Integrated Nanotechnologies, a Department of Energy nanoscale science research center jointly operated by Sandia and Los Alamos National Laboratories.

Member of National Institutes of Health special study sections, June, 2000; October, 2000, and nanotechnology special emphasis panels, July 2003, July 2004, February 2007; *ad hoc* member of BBCA study section, February, 2001.

Reviewer of proposals and member of review committees for federal agencies and private foundations, including NSF, DOE, and Research Corporation.

Member of organizing committee for the LANSCE Neutron Scattering Winter School, Los Alamos National Laboratory, January 2004.

Co-organizer of symposia on "Developing Nano-bio Interfaces" for 2005 Materials Research Society Spring meeting and on "Spatially Resolved Characterization of Local Phenomena in Materials and Devices" for 2002 Materials Research Society Fall meeting.

Member of Los Alamos National Laboratory Directed Research Strategy Team, Laboratory Directed Research and Development program, 2000-2002.

Member of Science Steering Committee, Institute for Complex Adaptive Matter, University of California, 2000-present.

Member of Executive Committee, Center for Nonlinear Studies, Los Alamos National Laboratory, 1999-present.

Invited participant in National Nanotechnology Initiative workshop on "Nanoscience Research for Energy Needs", Washington D.C., March 2004.

Reviewer for professional journals, including *Langmuir*, *J. Phys. Chem.*, *Inorganic Chem.*, *Journal of Raman Spectroscopy, Physical Review, Biophys. J.*, *Biochim. Biophys. Acta*, and *Proceedings of the National Academy of Sciences.*

Member of organizing committee for international workshop on "Efficient Energy Localization and Transduction in Life, Soft Matter and New Artificial Materials," sponsored by the Center for Nonlinear Studies of Los Alamos National Laboratory, Los Alamos, June 1999.

Member of organizing committee for 7th International Conference on Time-Resolved Vibrational Spectroscopy, Santa Fe, NM, June 11-16, 1995.

Publications:

54. A.P. Shreve, E.H. Haroz, S.M. Bachilo, R.B. Weisman, S. Tretiak, S. Kilina, S.K. Doorn, "Determination of exciton-phonon coupling elements in single-walled carbon nanotubes by Raman overtone analysis," *Phys. Rev. Lett.* (2007) in press.

53. S.K. Doorn, S. Goupalov, B.C. Satishkumar, A.P. Shreve, E.H. Haroz, S.M. Bachilo, R.B. Weisman, "Raman studies of electron-phonon coupling in single walled carbon nanotubes," *Phys. Stat. Solidi B – Basic Solid State Phys.* **243** (2006) 3171-3175.

52. R.C. Rocha and A.P. Shreve, "Characterization of infrared vibrational activity in specific totally symmetric bridging modes of localized-to-delocalized mixed-valence systems," *Chem. Phys.* **326** (2006) 24-32 (invited).

51. R.C. Rocha, M.G. Brown, C.H. Londergan, C.P. Kubiak, and A.P. Shreve, "Intervalence resonant Raman spectroscopy of strongly coupled mixed-valence cluster dimers of ruthenium," *J. Phys. Chem. A* **109** (2005) 9006-9012.

50. A.M. Dattelbaum, M.L. Amweg, J.D. Ruiz, L.E. Ecke, A.P. Shreve, and A.N. Parikh, "Surfactant removal and silica condensation during the photochemical calcination of thin-film silica mesophases," *J. Phys. Chem. B* **109** (2005) 14551-14556.

49. M.C. Howland, A.R.S. Butti, S.S. Dixit, A.M. Dattelbaum, A.P. Shreve, A.N. Parikh, "Phospholipid morphologies on photochemically patterned silane monolayers," *J. Amer. Chem. Soc.* **127** (2005) 6752-6765.

48. D.A. Doshi, A.M. Dattelbaum, E.B. Watkins, C.J. Brinker, B.I. Swanson, A.P. Shreve, A.N. Parikh, and J. Majewski, "Neutron reflectivity study of lipid membranes assembled on ordered nanocomposite and nanoporous silica thin films," *Langmuir* **21** (2005) 2865-2870.

47. R.J. Magyar, S. Tretiak, Y. Gao, H.-L. Wang and A.P. Shreve, "A joint theoretical and experimental study of polyphenylene-acetylene molecular wires," *Chem. Phys. Lett.* **401** (2005) 149-156.

46. G.A. Montaño, A.M. Dattelbaum, H.-L. Wang and A.P. Shreve, "Enhanced photoluminescence from poly(phenylene vinylene):dendrimer polyelectrolyte assemblies in solution," *Chem. Commun.* (2004) 2490-2491.

45. R.C. Rocha and A.P. Shreve, "Exploring the localized-to-delocalized boundary in mixed-valence systems using infrared spectroelectrochemistry," *Inorg. Chem.* **43** (2004) 2231-2233.

44. R. Wang, J. Shi, A.N. Parikh, A.P. Shreve, L.H. Chen and B.I. Swanson, "Evidence for cholera aggregation on GM1-decorated lipid bilayers," *Colloids and Surfaces B – Biointerfaces* **33** (2004) 45-51.

43. G.A. Montaño, A.M. Dattelbaum, W.G. Li, H.-L. Wang and A.P. Shreve, "Photoluminescence of a conjugated polymer-polyelectrolyte assembly and effective quenching in aqueous solution and on self-assembled thin film architectures," *Matls. Res. Soc. Symp. Proc.* **EXS-1** (2004) 359-363.

42. A.M. Dattelbaum, M.L. Amweg, J.D. Ruiz, L.E. Ecke, A.P. Shreve and A.N. Parikh, "Mechanism of surfactant removal from ordered nanocomposite silica thin films by deep-uv light exposure", *Matls. Res. Soc. Symp. Proc.* **788** (2004) 371-376.

41. C.H. Londergan, R.C. Rocha, M.G. Brown, A.P. Shreve and C.P. Kubiak, "Intervalence involvement of bridging ligand vibrations in hexaruthenium mixed-valence clusters probed by resonance Raman spectroscopy," *J. Amer. Chem. Soc*. **125** (2003) 13912-13913.

40. W.E. Buschmann, S.D. McGrane and A.P. Shreve, "Chemical tuning of nonlinearity leading to intrinsically localized modes in halide-bridged mixed-valence platinum materials," *J. Phys. Chem. A* **107** (2003) 8198-8207.

39. S.D. McGrane and A.P. Shreve, "Temperature dependent Raman spectra of triaminotrinitrobenzene: Anharmonic mode couplings in an energetic material," *J. Chem. Phys*. **119** (2003) 5834-5841.

38. R.E. Da Re, C.J. Kuehl, M.G. Brown, R.C. Rocha, E.D. Bauer, K.D. John, D.E. Morris, A.P. Shreve and J.L. Sarrao, "Electrochemical and spectroscopic characterization of the novel charge-transfer ground state in diimine complexes of ytterbocene," *Inorg. Chem.* **42** (2003) 5551-5559.

37. A.M. Dattelbaum, M.L. Amweg, L.E. Ecke, C.K. Yee, A.P. Shreve and A.N. Parikh, "Photochemical pattern transfer and enhancement of thin-film silica mesophases," *Nano Letters* **3** (2003) 719-722.

36. G. Kalosakas, A.R. Bishop and A.P. Shreve, "A nonlinear disorder model for Raman profiles in naturally abundant PtCl," *Phys. Rev. B* **66** (2002) 094303 (9 pages).

35. S. Franzen, S.E. Wallace-Williams and A.P. Shreve, "Heme charge transfer band III is vibronically coupled to the Soret band," *J. Amer. Chem. Soc.* **124** (2002) 7146-7155.

34. S. Franzen, V.M. Miskowski, A.P. Shreve, S.E. Wallace-Williams, W.H. Woodruff, M.R. Ondrias, M.E. Barr, L. Moore and S.G. Boxer, "Electrostatic and conformational effects on the electronic structures of distortional isomers of a mixed-valence binuclear Cu complex," *Inorganic Chemsistry*, **40** (2001) 6375-6382.

33. P.G. van Patten, A.P. Shreve and R.J. Donohoe, "Structural and photophysical properties of a water-soluble porphyrin associated with polycations in solution and electrostatically-assembled ultrathin films," *J. Phys. Chem. B,* **104** (2000) 5986-5992.

32. A.P. Shreve, S. Franzen, M.C. Simpson and R.B. Dyer, "Dependence of NO recombination dynamics in horse myoglobin on solution glycerol content," *J. Phys. Chem. B*, **103** (1999) 7969-7975.

31. R. Wang, A.N. Parikh, J.D. Beers, A.P. Shreve and B.I. Swanson, "Non-equilibrium pattern formation in Langmuir-phase assisted assembly of alkylsiloxane monolayers," *J. Phys. Chem. B*, **103** (1999) 10149-10157.

30. A.N. Parikh, J.D. Beers, A.P. Shreve and B.I. Swanson, "Infrared spectroscopic characterization of lipid-alkylsiloxane hybrid bilayer membranes at oxide substrates", *Langmuir*, **15** (1999) 5369-5381.

29. V.M. Miskowski, S. Franzen, A.P. Shreve, M.R. Ondrias, S.E. Wallace-Williams, M.E. Barr and W.H. Woodruff, "Distortional isomers of a mixed-valence binuclear Cu complex," *Inorganic Chemistry*, **38** (1999) 2546-2547.

28. J.P. Collman, S.T. Harford, S. Franzen, J.-C. Marchon, P. Maldivi, A.P. Shreve and W.H. Woodruff, "Resonance Raman, X-ray crystallographic and magnetic susceptibility studies of metal-metal bonded MoRu and WOs porphyrin dimers: 1. Evidence for an unusual MO diagram," *Inorganic Chemistry*, **38** (1999) 2085-2092.

27. J.P. Collman, S.T. Harford, S. Franzen, A.P. Shreve and W.H. Woodruff, "Resonance Raman and X-ray crystallographic studies of *inter*-triad metal-metal bonds: 2. WRu and MoOs porphyrin dimers," *Inorganic Chemistry*, **38** (1999) 2093-2097.

26. B.I. Swanson, J.A. Brozik, S.P. Love, G.F. Strouse, A.P. Shreve, A.R. Bishop, W.-Z. Wang and M.I. Salkola, "Observation of intrinsically localized modes in a discrete low-dimensional material," *Physical Review Letters*, **82** (1999) 3288-3291.

25. J.-F. Bardeau, A.S. Eberhardt, R.M. Nyquist, A.N. Parikh, A.P. Shreve and B.I. Swanson, "Phase-transition based transduction in a biosensor", *Synthetic Metals*, **102** (1999) 1452-1453.

24. J. Schoonover, A.P. Shreve, R.B. Dyer, R.L. Cleary, M.D. Ward and C.A. Bignozzi, "Time-resolved infrared studies on two isomeric ruthenium(II)/rhenium(I) complexes containing a nonsymmetric quaterpyridine bridging ligand," *Inorganic Chemistry*, **37** (1998) 2598-2601.

23. P.G. Van Patten, A.P. Shreve, J.S. Lindsey and R.J. Donohoe, "Energy-transfer modeling for the rational design of multiporphyrin light-harvesting arrays," *J. Phys. Chem. B*, **102** (1998) 4209-4216.

22. N.J. Cherepy, A.P. Shreve, L.J. Moore, S.G. Boxer and R.A. Mathies, "Temperature dependence of the Q_y resonance Raman spectra of bacteriochlorophylls, the primary electron donor, and bacteriopheophytins in the bacterial photosynthetic reaction center," *Biochemistry*, **36** (1997) 8559-8566.

21. N.J. Cherepy, A.P. Shreve, L.J. Moore, S.G. Boxer and R.A. Mathies, "Electronic and nuclear dynamics of the accessory bacteriochlorophylls in bacterial photosynthetic reaction centers from resonance Raman intensities," *J. Phys. Chem. B*, **101** (1997) 3250-3260.

20. A.P. Shreve and R.A. Mathies, "Thermal effects in resonance Raman scattering: Analysis of the Raman intensities of rhodopsin and of the time-resolved Raman scattering of bacteriorhodopsin," *J. Phys. Chem.*, **99** (1995) 7285-7299.

19. N.J. Cherepy, A.P. Shreve, L. Moore, S. Franzen, S.G. Boxer and R.A. Mathies, "Near-infrared resonance Raman spectra of the special pair and the accessory bacteriochlorophylls in the bacterial photosynthetic reaction center," *J. Phys. Chem.*, **98** (1994) 6023-6029.

18. P.J. Reid, A.P. Shreve and R.A. Mathies, "Resonance Raman intensity analysis of the photochemical hydrogen migration in 1,3,5-cycloheptatriene," *J. Phys. Chem.*, **97** (1993) 12691-12699.

17. A.P. Shreve, N.J. Cherepy and R.A. Mathies, "Effective rejection of fluorescence interference in Raman spectroscopy using a shifted excitation difference technique," *Appl. Spectroscopy*, **46** (1992) 707-711.

16. A.P. Shreve, T.G. Owens and A.C. Albrecht, "Dynamics and mechanisms of singlet energy transfer between carotenoids and chlorophylls: Light harvesting and non-

photochemical fluorescence quenching," in *Research in Photosynthesis: Proceedings of the IXth International Congress on Photosynthesis (Vol. I)*, ed. N. Murata (Kluwer: Dordrecht, The Netherlands 1992) 179-186.

15. A.P. Shreve, J.K. Trautman, H.A. Frank, T.G. Owens, J.B. van Beek and A.C. Albrecht, "On subpicosecond excitation energy transfer in light-harvesting complexes (LHC): The B800-850 LHC of *Rhodobacter sphaeroides* 2.4.1," *J. Luminescence,* **53** (1992) 179-186.

14. H.A. Frank, C.A. Violette, J.K. Trautman, A.P. Shreve, T.G. Owens and A.C. Albrecht, "Carotenoids in photosynthesis: Structure and photochemistry," *Pure and Applied Chemistry, **63*** (1991) 109-114.

13. A.P. Shreve, N.J. Cherepy, S. Franzen, S.G. Boxer and R.A. Mathies, "Rapid-flow resonance Raman spectroscopy of bacterial photosynthetic reaction centers," *Proc. Natl. Acad. Sci. USA*, **88** (1991) 11207-11211.

12. A.P. Shreve, J.K. Trautman, T.G. Owens and A.C. Albrecht, "A femtosecond study of electronic state dynamics of fucoxanthin and implications for photosynthetic carotenoid-to-chlorophyll energy transfer mechanisms," *Chemical Physics*, **154** (1991) 171-178.

11. A.P. Shreve, J.K. Trautman, H.A. Frank, T.G. Owens, and A.C. Albrecht, "Femtosecond energy transfer processes in the B800-850 light-harvesting complex of *Rhodobacter sphaeroides* 2.4.1," *Biochim. Biophys. Acta*, **1058** (1991) 280-288.

10. A.P. Shreve and A.C. Albrecht, "A three-photon fluorescence excitation study of the $S_0(A_{1g})$ to $S_1(B_{2u})$ transition in neat liquid benzene," *J. Chem. Phys.* **94** (1991) 5772-5773.

9. A.P. Shreve, J.K. Trautman, T.G. Owens and A.C. Albrecht, "Determination of the S_2 lifetime of β-carotene," *Chem. Phys. Lett.*, **178** (1991) 89-96.

8. J.K. Trautman, A.P. Shreve, T.G. Owens and A.C. Albrecht, "Femtosecond dynamics of carotenoid-to-chlorophyll energy transfer in thylakoid membrane preparations from *Phaeodactylum tricornutum* and *Nannochloropsis* sp.," in *Current Research in Photosynthesis: Proceedings of the VIIIth International Congress on Photosynthesis (Vol. II),* ed. M. Baltscheffsky (Kluwer: Dordrecht, The Netherlands 1990) 289-292.

7. A.P. Shreve, J.K. Trautman, T.G. Owens and A.C. Albrecht, "Carotenoid-to-chlorophyll singlet energy transfer: Direct evidence for involvement of the carotenoid 'A' state in an algal light-harvesting system," in *Current Research in Photosynthesis: Proceedings of the VIIIth International Congress on Photosynthesis (Vol. II),* ed. M. Baltscheffsky (Kluwer: Dordrecht, The Netherlands 1990) 293-296.

6. A.P. Shreve, J.K. Trautman, T.G. Owens and A.C. Albrecht, "Two-photon excitation spectroscopy of thylakoid membranes from *Phaeodactylum tricornutum*: Evidence for an *in vivo* two-photon allowed carotenoid state," *Chem. Phys. Lett.*, **170** (1990) 51-56.

5. J.K. Trautman, A.P. Shreve, T.G. Owens and A.C. Albrecht, "Femtosecond dynamics of carotenoid-to-chlorophyll energy transfer in thylakoid membrane preparations from *Phaeodactylum tricornutum* and *Nannochloropsis* sp.," *Chem. Phys. Lett.,* **166** (1990) 369-374.

4. J.K. Trautman, A.P. Shreve, C.A. Violette, H.A. Frank, T.G. Owens and A.C. Albrecht, "Femtosecond dynamics of energy transfer in B800-850 light-harvesting complexes of *Rhodobacter sphaeroides*," *Proc. Natl. Acad. Sci. USA,* **87** (1990) 215-219.

3. A.P. Shreve, R. Mulhaupt, W. Fultz, J. Calabrese, W. Robbins and S.D. Ittel, "Sterically hindered aryloxide-substituted alkylaluminum compounds," *Organometallics,* **7** (1988) 409-416.

2. S.D. Ittel, R. Mulhaupt, A.P. Shreve and U. Klabunde, "Vapor synthesis of high-activity Ziegler-Natta catalysts - Stereoregularity," in *Homogeneous and Heterogeneous Catalysis: Proceedings of the Fifth International Symposium on Relations Between Homogeneous and Heterogeneous Catalysis,* eds. Y. Yermakov and V. Likholobov (VNU Press: Utrecht, The Netherlands, 1986) 431-446.

1. A.P. Shreve, J.P.R.B. Walton and K.E. Gubbins, "Liquid drops of polar molecules," *J. Chem. Phys.,* **85** (1986) 2178-2186.

Manuscripts Submitted or in Preparation (as of December 2006):

[59] M.C. Howland, A.R. Sapuri-Butti, T.W. Allen, A.P. Shreve, and A.N. Parikh, "Evidence for leaflet-dependent redistribution of charged molecules in fluid supported phospholipid bilayers," in preparation for *Phys. Rev. Lett.*

[58] G.A. Montaño, M. Brown, A. Zurek, Y. Gao, H.-L. Wang, A.M. Dattelbaum, and A.P. Shreve, "Environmental control of polymer heterogeneity and photoluminescence: Polyelectrolyte assemblies of 2,5-methoxy-propyloxysulfonate phenylene vinylene (MPS-PPV)," in preparation for *Langmuir*.

[57] A.M. Dattelbaum, H.-L. Wang, A.N. Parikh, and A.P. Shreve, "Controlling the luminescence of a conjugated polymer encapsulated within ordered nanocomposite silica thin films," in preparation for *Langmuir*.

[56] W.E. Buschmann, B. Scott, R.J. Donohoe, B.I. Swanson and A.P. Shreve, "Synthetic control of defect content in $[Pt(en)_2Cl_2][Pt(en)_2](ClO_4)_4$," in preparation for *Chem. Materials*.

[55] C. Knutson, G. Benkö, T. Rocheleau, F. Mouffouk, J. Maselko, L. Chen, A.P. Shreve, S. Rasmussen, "Metabolic photo-fragmentation kinetics for a protocell," submitted to *Artificial Life*.

Books and Book Chapters:

2. S. Rasmussen, J. Bailey, J. Boncella, L. Chen, G. Collis, S. Colgate, M. DeClue, H. Fellerman, G. Goranovic, Y. Jiang, C. Knutson, P.-A. Monnard, F. Mouffouk, P. Nielsen, A. Sen, A. Shreve, A. Tamulis, B. Travis, P. Weronski, W. Woodruff, J. Zhang, X. Zhou, and H. Ziock, "Assembly of a minimal protocell", to be published in *Protocells: Bridging nonliving and living matter*, Eds., S. Rasmussen, M. Bedau, L. Chen, D. Krakauer, D. Deamer, N. Packard and P. Stadler, (MIT Press: 2007)

1. *Spatially Resolved Characterization of Local Phenomena in Materials and Nanostructures*, Eds. J. Piqueras, F.R. Zypman, D.A. Bonnell, A.P. Shreve; Materials

Research Society Symposium Proceedings, Volume 738 (Materials Research Society: Warrendale, PA 2003).

Patents, Applications and Disclosures:

2. "Conjugated polymer doped nanocomposite silica thin films", patent pending, A.M. Dattelbaum, A.P. Shreve, H.-L. Wang.

1. "Planar optical waveguide-based sandwich assay sensors and processes for the detection of biological targets including protein markers, pathogens and cellular debris", patent pending, B.I. Swanson, J. Martinez, K.M. Grace, W.K. Grace, A.P. Shreve.